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ABSTRACT

The effects of the self-instructional use of programed creativity materials was investigated with 648 regular and intellectually gifted fourth-, fifth-, and sixth-grade students, using the Purdue Creativity Training Program (PCTP), and with the Torrance Tests of Creative Thinking as a measurement. In general, the results indicated that the self-instructional use of the PCTP enhanced some divergent thinking abilities among students in the areas of verbal fluency and originality. However, the prediction that gifted students would make significantly greater score gains than regular students after treatment was not borne out. (Tabular data are included). (DLS)

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The Self-Instructional Use of Programmed Creativity-Training Materials with Gifted and Regular Students

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Abstract

The effects of the self-instructional use of programmed creativity materials for gifted and regular students were investigated. Programmed creativity training materials were used on an individualized basis. The Purdue Creative Thinking Program was made available for self-instruction for twelve weeks by half of the 648 fourth-, fifth-, and sixth-grade students; the other students comprised the control groups. Pre- and post-tests of creative thinking were administered. Experimental students attained significantly greater gains on verbal fluency and originality. Creative thinking abilities can be improved through self-instructional programmed materials for gifted and regular students.

The Self-Instructional Use of Programmed Creativity-Training Materials with Gifted and Regular Students

Fostering creative thinking abilities in children has been a subject of educational concern for more than twenty years. Accumulation of knowledge has exceeded our ability to keep pace with new ideas. New emphases on information processing, abstraction of ideas, and generation of new knowledge are emerging. These processes certainly call for creative thinking; all problem solving may require at least some minimum level of creative thinking (Guilford, 1975).

Creative thinking abilities of children can be enhanced by many diverse means (Davis, 1973; Torrance, 1972; Treffinger, 1977). Creativity training programs are one class of instructional materials designed to this end. Several programs have been established as effective in enhancing students' creative thinking abilities; none, however, has been tested on an individualized, self-paced basis, or for specific use with gifted students.

Individualization of instruction is generally viewed as a means of maximizing learning for each student. The needs, preferences, and capabilities of the individual have become a prime consideration in education (Weisgerber, 1971). Individualized, self-directed learning may hold particular promise for intellectually and creatively gifted students (Treffinger, 1975). Characteristics of gifted students typically include mention of the pre-disposition to be independent in thought

and judgment (Gallagher, 1975; Martinson, 1974).

The research vehicle used for this study, the Purdue Creativity Training Program (PCTP, Feldhusen, Treffinger, & Bahlke, 1970) is a set of programmed materials that has been the focus of several previous investigations. It consists of twenty-eight audio-taped stories and presentations, each accompanied by printed exercises for the development of verbal and figural creative thinking abilities. Previous research with the PCTP has shown that it is effective in fostering creative thinking abilities, problem solving and related attitudes (Feldhusen, Bahlke, & Treffinger, 1969; Feldhusen, Treffinger, & Bahlke, 1970; Feldhusen, Treffinger, & Thomas, 1971; Robinson, 1969; Shively, Feldhusen, & Treffinger, 1972; Treffinger, Speedie, & Brunner, 1974).

The present study involved utilization of the PCTP on a self-instructional basis. Research with the PCTP and other programmed creativity instructional materials led to an expectation that the program would be effective on a self-instructional basis (Olton, Wardrop, Covington, Crutchfield, Goodwin, Klausmeier, & Ronda, 1969; Shcakel & Lawrence, 1969; Shively, Feldhusen, & Treffinger, 1972; Treffinger, Speedie, & Brunner, 1974). In these studies the teacher's role was deliberately held to a minimum while teachers gave instructions, played the tapes, and distributed the exercise sheets. Results indicated that several programs, including the PCTP, were successful in enhancing subjects' divergent thinking, with minimal teacher interaction.

Training gifted students' creative thinking abilities is also commonly emphasized in the literature in education of the gifted and talented (Barbe & Renzulli, 1975; Gallagher, 1975). Thus programmed creativity training materials were used as an effort to enhance the creative thinking abilities of gifted students.

The specific research question was: Can the PCTP, if used in a self-paced mode, improve the creative thinking of regular and gifted children? In addition, the following questions were asked: Will the implementation of the PCTP on a self-paced basis be more effective for gifted students than for regular students? Will the PCTP be equally effective for grades four, five, and six? Will there be differential effects for grade level and class type for the treatment groups?

Methods and Procedures

Six hundred forty-eight subjects from six school buildings in grades four, five, and six were selected from an urban public school system. Three hundred nine subjects were enrolled in self-contained classes for intellectually gifted students and 339 were enrolled in regular classrooms in the same attendance centers. Eighteen classes, consisting of one gifted and one regular class at each grade level in each of three schools were randomly designated as experimental groups. The remaining eighteen classes received no experimental instructional program. The number of students for each cell is presented in Table 1.

Insert Table 1 about here

The school population was representative of other cities of its size (200,000 - 300,000). The schools in the sample were comparable in socioeconomic status and distribution of sex and race of students and were substantially representative of the total school population in the city.

The gifted program provides an enriched learning environment for pupils of high academic potential. Specific criteria for eligibility for this program included:

1. Academic excellence in the regular program, prior to selection;
2. I.Q. score of 125 on an individual test, and at least two years above grade level on standardized achievement tests;
3. Good emotional, social, and personal development, as evaluated by the professional staff.

Research Design

A two by two by three multivariate analysis of variance was employed. Independent variables were instructional program or no program (PCTP vs control), class type (gifted vs regular) and grade level (four, five, or six). The six dependent variables were the verbal and figural fluency, flexibility, and originality scores from the Torrance Tests of Creative Thinking (Torrance, 1974). Pre- and post-test score differences (post-test minus pre-test score) were computed and the unit of analysis were the gains of

individual students. Figure 1 presents a graphic representation of the design of the study.

There were unequal numbers of subjects in each cell of this research design (Table 1). The computer program used for this research, BMD X 64, was designed to handle MANOVA designs with unequal cell sizes; therefore no effort was made to randomly equalize group sizes.

Insert Figure 1 about here

Instruments and Scoring

A battery of tests from the Torrance Tests of Creative Thinking (TTCT, Torrance, 1974) were used as criterion measures. As operationally defined for this study, creative thinking abilities consisted of verbal and figural fluency, flexibility and originality. Fluency was defined as the number of relevant responses to the test tasks. Flexibility was the number of different approaches or categories ues in producing responses. Originality was measured by computing the statistical infrequency of responses. All scoring was conducted by trained scorers following the procedures described by Torrance (1974).

Five subtests of the TTCT, three verbal and two figural, were employed. The verbal tests were Product Improvement, Just Suppose, and Unusual Uses; the Figural subtests were Repeated Figures and Incomplete Figures. Alternate forms of these tests were administered as pre- and post-tests. Scores for each of the verbal and figural tasks were analyzed

separately, yielding six dependent variables. Intra-rater reliabilities ranged from .85 to 1.0 for the six variables.

Reliability and Validity of the TTCT

Numerous studies were cited by Torrance (1974) supporting the reliability of the Torrance Tests of Creative Thinking. Of particular interest was the report by Torrance (1971), concerning the predictive validity of the TTCT, for both short-range and long-range studies. The evidence presented was highly supportive of the ability of the TTCT to predict creative behavior on a wide range of criterion measures.

Although the TTCT are not comprehensive in the measurement of all facets of creative behavior, Torrance (1974) contended that the tests sample a wide range of the abilities in such a universe. Treffinger, Renzulli and Feldhusen (1971) proposed that measures of divergent thinking such as the TTCT may be viewed as necessary and useful, but not sufficient component in the assessment of creative potential. Treffinger and Poggio (1972) suggested that divergent thinking tasks would be correlated with a more comprehensive measure of creative functioning, but that the more comprehensive measure would also be related to other cognitive abilities.

Data Collection Procedures

Prior to placing the PCTP in the classrooms, two meetings were held with the teachers whose classes received the treatment. The nature and purpose of the research were outlined and discussed. Mimeographed instructions were distributed that included a description of the PCTP and

suggestions for individualizing the program. The instructions asked that the teachers avoid examples of specific responses to the exercises and to avoid evaluations of the students' responses to the exercises.

Five subtests from the TTCT, Form B, were administered to all students before the instructional period with the PCTP began in the experimental groups. Three verbal and two figural tasks were administered with eight minutes allowed for each task. The tests were administered by trained members of the research staff in the students' regular classrooms.

Students in the experimental classes used the PCTP over a twelve week period. Classes in the control group continued normal activities with no special instructional treatment.

At the end of the twelve week instructional period the corresponding five subtests from the TTCT, Form A, were administered to all students.

Treatment of Data

The data were analyzed using a 2 X 2 X 3 multivariate analysis of variance for unequal cells. Independent variables were: class type (Gifted or regular); treatment (PCTP or control); grade (four, five or six). The six dependent variables were verbal and figural fluency, flexibility, and originality. Analyses were conducted using simple gain scores (post-test minus pre-test).

A multivariate analysis of variance (MANOVA) was conducted; where significant values occurred for Wilk's

(1932) lambda criterion (Λ) univariate analyses were conducted for each dependent variable. When significant F's were obtained on the ANOVAs, appropriate Scheffé post-hoc contrasts were conducted. The .05 level of significance was the criterion for all tests.

Results

Differences among groups prior to treatment were determined by 4 X 1 ANOVAs and post-hoc Scheffé tests on TTCT pretest scores for grades four, five, and six. For the ANOVAs the independent variables were four groups of subjects: 1) Gifted experimentals; 2) Gifted controls; 3) regular students in experimental groups; and 4) regular students in control groups. The dependent variable for each of the ANOVAs was a creative thinking component (verbal and figural fluency, flexibility, or originality) for each of the verbal and nonverbal subtest tasks. For example, on one ANOVA the dependent variable was the fluency score derived from the verbal task "Product Improvement". Results from analyses indicated a trend for Gifted subjects to score higher on verbal subtests and for subjects in regular classes to score higher on nonverbal tasks except for the sixth grade. The Gifted sixth grade subjects exhibited a trend to also be superior to regular students on figural tasks. A trend for the fifth and sixth grade Gifted experimentals to be superior initially to Gifted controls on verbal tasks was indicated.

As shown in Table 2, the MANOVA revealed significant ($p < .05$) differences in the group centroids for the main effects of class type, treatment and grade. Treatment by

grade and treatment by grade level by class type interactions were also significant. There were no significant differences in the group centroids of either class type by treatment or class type by grade interactions. Table 3 gives the mean

Insert Table 2 about here

TTCT gain scores for experimentals and controls by class type.

Insert Table 3 about here

To determine the source of the differences that were significant on the MANOVA, univariate ANOVAs were conducted for each dependent variable. Table 4 summarizes the significant results of the univariate ANOVAs on TTCT gain scores. For verbal fluency two main effects were significant: class type ($F = 11.41$, $p < .05$ with 1 and 636 df) and treatment ($F = 11.56$, $p < .05$ with 1 and 636 df). For verbal originality class type ($F = 3.73$, $p < .05$ with 1 and 636 df) and treatment ($F = 3.65$, $p < .05$ with 1 and 636 df) were significant. Since

Insert Table 4 about here

the hypotheses for this research concerned treatment effects, no other results are discussed. For verbal fluency the treatment group (PCTP) mean gain scores (4.23) were significantly greater than the mean gain scores (o.o4) of the no-treatment group. On verbal originality the treatment group mean gain scores (0.73) were significantly greater than the control group mean gain scores (-2.78). Although class

type by treatment interaction for figural flexibility was significant in univariate analysis, it was not further analyzed due to its non-significance on the MANOVA.

Interpretation and Discussion

In general, the results of this research warrant the conclusion that the self-instructional use of the PCTP enhanced some divergent thinking abilities among students. The experimental groups had significantly greater gain scores for verbal fluency and verbal originality than did the control groups.

Previous research with the PCTP (Feldhusen, Bahlke, & Treffinger, 1969) reported significant gains on the Torrance Tests variables of verbal fluency and originality. The subjects were third, fourth, and fifth grade students. Robinson (1969) used the PCTP with fourth grade students and significant gains were made by instructed groups on verbal fluency and originality. The TTCT produced the criterion variables. Using the PCTP with fourth, fifth, and sixth grade students, Feldhusen, Treffinger, and Thomas (1971) reported significant gains for verbal fluency and originality on the Torrance Tests. In a longitudinal study seven months later, Speedie, Treffinger, and Feldhusen (1971) found that gains made on all TTCT variables by fourth grade students held. Shively, Feldhusen, and Treffinger (1972) found significant gains for treatment groups on verbal fluency and originality under conditions of no class or teacher discussion, for students in grades four, five, and six.

The most recent prior research with the PCTP (Treffinger, Speedie, & Brunner, 1974), reported significant gains on verbal fluency and originality for instructed groups of students in grades four, five, and six.

Verbal fluency and originality have consistently been enhanced by training with the PCTP. Implementing the PCTP on a self-instructional basis also produced significant gains on these variables, in spite of the problems discussed later with individualizing instruction.

No significant interaction between class type and treatment was found, Gifted and regular students performed equally well on treatment. The Gifted students were predicted to make significantly greater score gains than regular students partly due to the self-instructional use of the PCTP. Characteristics of gifted and creative students (Feldhusen, Elias, & Treffinger, 1969) lent support for this expectation. Further, Feldhusen (1963) concluded that gifted students have superior achievement on programmed materials compared to average ability students. Research from Shackel and Lawrence (1969), Stolurow (1972) and Hanson and Komalski (1965) found that gifted and original students make greater gains on achievement with programmed materials than did gifted students traditionally taught.

The lack of predicted interaction between treatment and class type could have been caused by many factors. The self-contained classes for gifted students are fast-paced with many diverse activities. The competition between the regular activities and the PCTP may have mitigated against

the use of the PCTP. Additionally, the PCTP was designed for regular students in grades three, four, and five and was found, through research, to be better suited to grades four, five, and six (Feldhusen, Bahlke, & Treffinger, 1969). Reports by the teachers of the sixth grade Gifted students indicated that the PCTP was below the ability level of the students. One of the criteria for selection for the Gifted classes is two years above grade level on standardized achievement tests. It could also be that the PCTP does not meet some of the criteria outlined by Feldhusen, Elias, and Treffinger (1969) for the right kind of programmed instruction for the fifth and sixth grade students.

Although MANOVA found treatment by grade level interaction significant, subsequent univariate analyses failed to indicate the source of this interaction. In one study with the PCTP (Feldhusen, Treffinger, & Thomas, 1971), the fourth grade students made significant gains on all TTCT variables, while the fifth grade students made significant gains over controls on verbal flexibility and figural fluency, flexibility, and originality. Sixth grade subjects made greater score gains on verbal fluency and originality and figural fluency and flexibility. Robinson (1969) found significant differences on all TTCT variables for fourth grade students; no fifth or sixth grade students were included in this study. In a longitudinal study (Speedie, 1971), the TTCT gains held over a seven month period for fourth grade students while the fifth and sixth grade students failed to maintain their gains. The prediction

was that the PCTP would be more effective with fourth grade students.

A significant class type by treatment by grade level was found by MANOVA but further univariate analyses on each dependent variable failed to indicate the source of the interaction. This is not unusual in MANOVA since the correlated variables can reach significance if considered in combination, but might not be significant singly (Winer, 1962).

Fourth grade Gifted students were expected to make greater gain scores than the regular fourth grade students as well as Gifted fifth and sixth grade students and regular students due to treatment. This prediction was made in recognition of the intellectual maturity level of the Gifted students and knowledge of the sophistication level of the PCTP. The use of the PCTP on a self-selected basis, rather than group instruction is a severe test of the materials. Older Gifted students might not have remained actively involved in the instruction because the verbal content of the taped stories may not have been adequately challenging for them.

Another possible explanation can be drawn from research with the Productive Thinking Program (Olton, et al., 1967; Wardrop, et al., 1969). Students with higher IQs attained higher pre-test scores on creative thinking tests and maintained their rank order relationship to the other students on the post-test, but did not make greater increments of score gains.

Implementing any educational program or curriculum on an individualized basis is fraught with problems. Many experienced teachers were not trained to individualize instruction for their students. It may be very difficult for such teachers to move away from teacher-controlled, expository teaching. Other teachers do not believe that children can direct their own learning activities effectively. This attitude can influence the success of efforts in that direction by colleagues, researchers, or students. In the classroom the PCTP constituted only a very small part of the total school program and classroom environment. It may not have involved ample time for students to learn to develop the skills needed for self-directed learning, even among gifted students. Learning styles, personality variables, and previous experiences can influence the willingness of children to undertake learning on their own. Systematic assistance may therefore be needed to assist students and teachers to implement self-directed learning models successfully and efficiently (Mosston, 1972; Treffinger, 1975, 1978).

Absence of gains on the figural variables may have been related to the specific choices of tapes and exercises made by the students. Some of the tapes and exercises provided more opportunities for the exercise of figural abilities than others. Alternatively, it is possible that the figural abilities, along with verbal flexibility, require greater instructional efforts, student practice, or teacher interaction than was attained through the self-instructional approach.

Limitations of Research

The analyses of pre-test scores for all subjects revealed a trend toward superiority of the Gifted subjects on verbal tasks for the fourth grade, and for verbal and figural tasks for fifth and sixth grade students. To the degree that the TTCT have ceilings, this initial superiority could have contributed to two effects: 1) the lack of superior gain scores for the Gifted students as was hypothesized, and 2) the lack of significant gain scores on non-verbal tasks due to treatment. A ceiling effect for non-verbal tasks could be due to the numbers of circles, pairs of lines and incomplete figures presented to the subjects. Since the verbal tasks are more open-ended, a ceiling effect is more difficult to discern, although there is a limit to the number of pages where children may write their ideas, and the amount of time given to each subtest. Future research with gifted children might take these considerations into account and elucidate this problem.

Conclusions

The results of this study provided limited, but significant, support for the effectiveness of programmed creativity instructional materials when implemented on a student-directed basis. The program was successful in influencing verbal fluency and originality for gifted and regular students in grades four, five and six.

Future research may be directed profitably to several questions. What are the effects of group instruction with

the PCTP on gifted students' creative thinking abilities? What are the effects of using other creativity instructional programs on a self-instructional basis? How can students learn to manage and direct their own learning, creative thinking and problem-solving? What are the influences of various student characteristics and teacher influences upon the success of individualized, learner-directed creativity instructional programs?

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Table 1

Distribution of Subjects by Cell

Grade level	Experimental		Control		$\Sigma\downarrow$
	Gifted	Regular	Gifted	Regular	
4	55	64	49	52	220
5	47	60	51	46	204
6	52	63	55	54	224
$\Sigma\rightarrow$	154	187	155	152	648

Table 2

Results of MANOVA in Order of Hypotheses Tested

Effect tested	Computed value[1] of multivariate U statistics	Critical value and degrees of freedom of multivariate U statistics
A B C (Class Type x Treatment x Grade)	U = 0.9646*	$U^{.05}_{(6,2,600)} = 0.9654$
Main Effect A (Class Type)	U = 0.9577*	$U^{.05}_{(6,1,600)} = 0.9791$
Main Effect B (Treatment)	U = 0.9560*	$U^{.05}_{(6,1,600)} = 0.9791$
Main Effect C (Grade)	U = 0.9591*	$U^{.05}_{(6,2,600)} = 0.9654$
A B Interaction (Class Type x Treatment)	U = 0.9860 (n.s.)	$U^{.05}_{(6,1,600)} = 0.9791$
B C Interaction (Treatment x Grade)	U = 0.9584*	$U^{.05}_{(6,2,600)} = 0.9654$
A C Interaction (Class Type x Grade)	U = 0.9823 (n.s.)	$U^{.05}_{(6,2,600)} = 0.9654$

*$p < .05$

n.s. = non-significant

[1]Result of MANOVA
Significant values are smaller than critical values

Table 3

Mean TTCT Gain Scores for Experimental and Control Treatment Groups by Class Type Averaged Across Grades

Variable	Class type	Treatment	
		Experimental	Control
Verbal fluency	Regular	2.72	-2.74
	Gifted	6.05	2.76
	Treatment means	4.23	.04
Verbal originality	Regular	.38	-6.28
	Gifted	1.15	.64
	Treatment means	.73	-2.78

Table 4

Summary of Significant Effects in Univariate Analysis of Variance on Each Dependent Variable

Dependent variables	Independent significant variables	p level
Verbal fluency	Class type	.001*
	Treatment	.001*
Verbal flexibility	Grade	.02*
Verbal originality	Class type	.05*
	Treatment	.05*
Figural fluency	Grade	.002*
Figural flexibility	Class type by treatment	.04*
Figural originality	-----	N.S.

*$p < .05$

Figure 1. General Research Design